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PROGRESS REPORT
of the
HUMAN NUTRITION RESEARCH DIVISION
AGRICULTURAL RESEARCH SERVICE

This progress report includes a summary of the current research of the Division and a preliminary report of progress made during the preceding year. It is primarily a tool for use of scientists and administrators in program coordination, development and evaluation; and for use of advisory committees in program review and development of recommendations for future research programs.

The summaries of progress on USDA and cooperative research include some tentative results that have not been tested sufficiently to justify general release. Such findings, when adequately confirmed, will be released promptly through established channels. Because of this, the report is not intended for publication and should not be referred to in literature citations. Copies are distributed only to members of Department staff, advisory committee members and others having a special interest in the development of public agricultural research programs.

This report also includes a list of publications reporting results of USDA and cooperative research issued between July 1, 1967, and June 30, 1968. Current agricultural research findings are also published in the monthly USDA publication, Agricultural Research. This progress report was compiled in the Human Nutrition Research Division, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Maryland.

UNITED STATES DEPARTMENT OF AGRICULTURE
Washington, D.C.
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INTRODUCTION

The research reported here presents recent progress in understanding the nutritional needs of normal man and the manner by which these needs can best be met by food. The research involves studies of the absorption, transport, and metabolism of individual nutrients in the body as related to age, activity, heredity, and environmental conditions. Studies of metabolic processes and nutritional requirements in man are preceded, guided, and expedited by results from intensive studies on laboratory animals and lower forms of life in which more factors can be controlled and physiological responses can be measured during each stage in the life cycle and during successive generations. The research includes the nutritive and other consumer values of foods as measured by chemical or physical means and by biologic response, and the effects of household practices upon the nutritive value and inherent qualities of foods. Investigations are made also of the effect of pesticide use upon human nutrition, food needs and uses. Knowledge gained from human nutrition research can be used to influence the food habits and improve the nutritional status of man. It also can influence market demand and in turn the production of agricultural products.

The program is carried on by the Human Nutrition Division of the Agricultural Research Service of the U. S. Department of Agriculture. It is conducted at the Agricultural Research Center near Beltsville, Maryland, and under contract and cooperative agreement and grants with universities, industry, and private research laboratories. In addition, the Division collaborates with Regional programs of the State Experiment Stations. The Federal Scientific effort devoted to this research in Fiscal Year 1968 totalled about 41.4 scientific man-years with 36.0 engaged in the program near Beltsville, Maryland, and at Boston, Massachusetts, ^{1/} and the equivalent of 5.4 in contract, grant and cooperative agreements. The program is divided among study of:

	Intramural	Extramural	Total
Human requirements for nutrients and foods	16.0	3.8	19.8
Quality of food in homes and institutions	9.6	0	9.6
Safety of food in homes and institutions	1.2	0	1.2
Effect of pesticide use upon human nutrition	9.2	1.6	10.8

^{1/} field location for the period June 1967 - June 1969

Basic information on human nutrition is needed for conservation and optimal utilization of human and food resources and to promote the nutritional well-being of the population. The Division has contributed to this goal by providing information on nutritional and food needs and on the qualities of foods which influence their usefulness to consumers. Some of these contributions have been summarized here:

High levels of unsaturated fat in diet may increase cholesterol levels. Research by ARS scientists indicates that a diet containing a relatively high level of unsaturated fat may increase rather than reduce blood cholesterol levels. The diets contained cholesterol and were identical except for the relative amounts of saturated and unsaturated fat. The diet high in unsaturated fat contained safflower oil and the diet low in unsaturated fat contained a hydrogenated vegetable oil. The serum and liver cholesterol levels of rats at 250 days of age were lower with the diet containing hydrogenated vegetable oil than with the diet containing safflower oil. Although cholesterol levels in the blood increased with age with both diets, some extremely high levels were observed with safflower oil. The cause for the elevated cholesterol levels with safflower oil, in contrast to the reverse effect frequently reported, is being investigated.

Diets containing low levels of copper affect development of the nervous system. ARS research shows that adequate levels of copper are important in the diet of the mother for reproduction and for normal development of offspring. Female rats fed a diet low in copper throughout life grew normally but had fewer pregnancies and greater mortality of the young than normal. Moreover, within 6 weeks of birth the offspring became easily irritated by noise which led to "running fits." Lesions were seen in their nervous tissue and brain; heart lesions were seen occasionally. There was evidence that the symptoms of copper deficiency may be accentuated by the presence in the diet of a mixture of insecticides at levels below FDA tolerances. With addition of the insecticides to the mother's diet, survival of the young to weaning was poorer and heart lesions were more frequent and more severe. The research was conducted under contract by scientists at Purdue University.

Up-to-date information on nutrient content of wheat products. A study covering all regions of the United States has provided the most extensive information yet available on the nutritive value of wheat and wheat products. Results show that processing into white flour removed a major part of many B vitamins, minerals, and the vitamin E components of the wheat grain. Vitamin B₆ showed the greatest loss--70 percent or more in the milling, with a net loss of 75 percent or more from the wheat to the

baked product. Losses in milling for thiamine and riboflavin, two of the B vitamins that are added to flour and bread in the enrichment program, were smaller than for Vitamin B₆. Analyses of a variety of wheat products available on the consumer market showed them to have nearly the same content of major nutrients in all regions of the country. The foods studied from two cities in each of five regions included enriched white breads, whole wheat bread, hamburger rolls, doughnuts, all purpose flour, biscuit mix and different types of breakfast cereals. The study provides the most extensive data ever obtained on the major nutrients in wheat and wheat products from the grain stage to the consumer product and shows the effects of modern milling and baking processes on nutrient content.

"Family Fare," USDA's food-use guide revised. "Family Fare: Food Management and Recipes," USDA's most popular publication, has been revised and updated. The new "Family Fare" prepared by Human Nutrition Research Division food specialists in cooperation with Consumer and Food Economics Research Division nutritionists summarizes the results of years of food and nutrition research in an up-to-date handbook designed for everyday use. It tells the homemaker how to select a variety of foods to provide needed nutrients and presents tested recipe and suggestions for well-balanced menus. "Family Fare" was originally published at the request of Congress, whose members asked that accurate nutrition information and tested recipes be combined under one cover for the benefit of "the people back home." It is the successor to "Aunt Sammy's Radio Recipes," a bestseller of the 1920's and 1930's and probably the first cookbook to be translated into Braille. Almost 7 million copies of "Family Fare" have been distributed during the past 10 years.

AREA NO. 1: HUMAN REQUIREMENTS FOR NUTRIENTS AND FOODS

(RPA 708 - HUMAN NUTRITIONAL WELL-BEING)

USDA and Cooperative Program

Location of Intramural Work	Scientist Man-years FY 1968
Maryland (Beltsville)	15.0
Massachusetts (Boston) <u>1/</u>	1.0
	<hr/>
	Total 16.0

Intramural program is supplemented by extramural support representing (a) 0.0 SMY's at State Agricultural Experiment Stations, (b) 3.8 SMY's at other U. S. institutions, and (c) P.L. 480 funds in 1 country representing \$8,300 U. S. dollars equivalent.

1/ field location for the period June 1967 to June 1969

Problems and Objectives

Nutritional requirements must be expressed in terms of foods and diets if advances in nutritional knowledge are to benefit people. Despite the near eradication of major deficiency diseases in the U. S. less obvious but debilitating aspects of improper nutrition are widespread. The benefits of nutrition research include improved health, a longer productive life, a greater sense of well-being, and fewer work days lost. Economic benefits are difficult to quantify. One example relates to heart and vasculatory diseases which were diagnosed or suspected in 28 million adults during 1960-62. The economic costs of deaths from heart disease were calculated as \$31.9 billion in 1962. When nutrition research has progressed sufficiently that specific dietary recommendations can be made, it may be possible to modify a sizeable percent of the heart and vasculatory cases and increase the productive life span and work efficiency of people with tendency toward such afflictions.

Major objectives of research are to:

1. determine individual human requirements for specific nutrients in food supply
2. assess the nutritional values present in each of our foods
3. ascertain the extent and nature of the nutritional problems in the U. S.

Progress - USDA and Cooperative Program

A. Nutritional Status

An evaluation was made of published reports of clinical and biochemical studies of the nutritional status in an effort to identify the incidence and location of hunger and malnutrition in the U. S. The quality of nutrition was generally related to economic status and level of education. Those with the poorest diets, as determined from dietary and biochemical evaluation, were people in rural communities in Puerto Rico, Indians on reservations in the West, Eskimos, Aleuts and Indians in Alaska, Negro migrant agricultural workers, older people, and teenagers from low-income families in urban areas. Iron-deficiency anemia was common in pregnant women and infants. The foods most needed to improve diets were milk, citrus fruits, and green and yellow vegetables. This literature study was made in response to a request by the Committee on Agriculture, U. S. House of Representatives in their hearings on the Stennis Bill to "Provide Food and Medical Services on an Emergency Basis."

B. Dietary Carbohydrates

1. Effect on blood lipids in man. The kind of dietary carbohydrate was found to have little effect on blood lipids during short term studies with 9 young men and 10 young women. The men and women ate diets in which 85 percent of the carbohydrate (40 percent of the calories) was supplied by cooked wheat starch or by sucrose. No significant differences in serum levels of cholesterol, phospholipids, or glycerides were noted between wheat and sugar. Long term studies in this Division have shown that fat and cholesterol metabolism in rats can be altered by the kind of dietary carbohydrate. The extent and manner of change varies with the strain. The application of the results to humans is still to be established.
2. Effect on enzymes involved in fat metabolism. The activities of three enzymes involved in fat metabolism, glucose-6-phosphate dehydrogenase, 6-phosphogluconate dehydrogenase, and pyruvate kinase, were lower in the livers of rats fed starch than in rats fed sucrose. The enzymes also were significantly less active when the diet was high in cholesterol (25 percent dried egg) than when the diet did not contain egg. Differences due to type of carbohydrate were still apparent when the diets contained cholesterol but were small compared with the reduction in enzyme activity resulting from the presence of egg in the diet. The high levels of fat and cholesterol in the livers of the rats fed the egg diet do not appear to be associated with the level of activity of these enzymes.

Research carried out in Israel under a PL 480 grant has provided evidence that another enzyme involved in fat metabolism, lipoprotein lipase, is also influenced by the type of dietary carbohydrate. Fructose, one of the simple sugars in sucrose has been suggested as the factor responsible for the high levels of fat observed in the blood. The Israel investigators report that when the diet contains fructose the activity of lipoprotein lipase in adipose tissue is reduced and blood fat increases in contrast to the high activity of this enzyme and lower blood fat that is found when glucose is fed. They suggest that this enzyme is active in maintaining an equilibrium between adipose tissue, liver and blood. The low activity of this enzyme observed in body fat when fructose is fed upsets the mechanism controlling fat metabolism and blood fat becomes elevated.

C. Dietary Fat

Additional information has been obtained on the effect of the kind of dietary fat on cholesterol metabolism. On low cholesterol diets, serum cholesterol in rats was high when the dietary fat was a blend similar in composition to fats consumed by people in the U. S. The elevation in serum cholesterol was not found when the dietary fat was a hydrogenated vegetable shortening (HVO). Liver cholesterol was low and similar for both fats. When the diets were high in cholesterol (25 percent dried egg), both liver and serum cholesterol levels were high and increased with age. The increase with age was more rapid with the blend of fats and with safflower

oil than with HVO. Some extremely high levels of cholesterol were observed in older rats fed safflower oil. More body fat was found with the low than with the high cholesterol diet even when food consumption and body weights were similar.

New information on hormonal control of cholesterol metabolism has come from research under a PL 480 grant in India. Female rats were found to synthesize and to break down cholesterol in the liver faster than males. However, serum cholesterol levels tended to be higher in females. Diets without fat lowered the rate of synthesis by males and females but was without influence on the ability of the liver to break down cholesterol. Sex differences in the ability to degrade cholesterol were greater in animals fed diets containing cholesterol than in those fed low fat diets.

A research grant has been negotiated with the University of Nebraska to determine the influence of level and degree of saturation of dietary fat on physical development, intelligence and survival. Information will also be obtained on the effect of vitamin E on response to polyunsaturated fat.

D. Dietary Protein

1. Amino acid requirements. Two research grants have been initiated to further our knowledge of amino acid requirements of people. At Cambridge, Massachusetts a rapid sensitive method will be developed for quantitating individual human requirements for essential amino acids.

At Baltimore, Maryland, researchers will study the effect of prior nutrition upon children's requirement for lysine, methionine and threonine.

2. Wheat as a protein source for adults. Wheat provided the protein needs of 12 young Negro men in diet studies carried out under contract at Greensboro, North Carolina.

Nitrogen balance was maintained during a 75-day period in which 35 grams of protein was supplied by wheat or wheat supplemented with pinto beans, rice, or peanuts and 12 grams by fruits and vegetables. Mean plasma cholesterol, phospholipid, and glyceride levels were slightly but not significantly lower with the wheat diets than they had been before the study started. Plasma total lipid levels fell during the first 30 days and then rose gradually to levels that were slightly lower than but not significantly different from the initial levels. Plasma total essential amino acids also fell during the first 30 days of the study. By the end of 75 days, however, they had risen again to the initial levels. This readjustment back to initial levels of blood components during the last 45 days of the 75-day study indicates the need for long term observations with human subjects when evaluating foods or food supplements for human consumption.

3. Production of antibodies. Results from research carried out under a grant with Iowa State University suggest that measurements of the number of antibody producing cells in the spleen may provide a useful index of the protein quality of the diet. Although the level of antibody in the blood responds to quality and quantity of protein in the diet it appears to be a less sensitive index than the number of antibody producing cells in the spleen. There were more antibody producing cells in the spleen of rats fed a mixture of protein (3.3 percent from rice and 1.7 percent from mung bean) than when the diet contained 5 percent protein all from rice. Level of antibody in the blood was the same for both diets. When the diet contained 5 percent protein from rice and 2.5 percent from mung beans, the number of antibody cells in the spleen increased and antibody titer in the serum also increased. Results from the supplementation of rice with an amino acid mixture similar to that supplied by mung beans were similar to those observed with the protein mixture.

4. Utilization of wheat nitrogen. Young rats were able to utilize the amide nitrogen of glutamine less efficiently than an equal quantity of alpha-amino nitrogen from glutamic acid when these were the sole sources of nonessential nitrogen in the diet. However, no differences in nitrogen utilization were demonstrated between two groups of rats fed different levels of amide nitrogen as wheat. It would appear, therefore, that any failure to utilize part of the amide nitrogen would not limit protein synthesis when the usual wheat-containing diet is fed. Research is underway to obtain more information on the influence of age and the possible effect of caloric intake on the utilization of amide nitrogen.

5. Availability of methionine in heated foods. In preliminary studies of the cause of lowered nutritional availability of methionine in heated foods, an amino acid-sugar (1:1) compound has been isolated from a heated mixture of methionine and glucose. This compound was unable to replace methionine in rat diets, although it was 80 percent as effective as methionine in supporting the growth of microorganisms. Efforts are underway to characterize the compound by nuclear magnetic resonance.

E. Minerals

1. Calcium requirements. The ability of the body to adapt to low calcium intake has made it difficult to establish its requirement. Research under a grant with the University of Louisville is providing information that may clarify the mechanism by which the adjustment is made. Rats fed diets with 0.5 percent calcium for either 1 or 5 weeks after weaning had more calcium-binding protein in the intestine than rats fed diets with 1.5 percent calcium. The increase in the calcium-binding protein, which is believed to play a role in the absorption of calcium from the intestine, may be an adaptation allowing for better utilization of calcium under conditions of low intake.

F. Vitamins

B-vitamin synthesis in tempeh. Fermentation of soybeans by mold, Rhizopus oligosporus, to produce tempeh yielded an increase in folic acid within the first 48 hours. There were similar increases in biotin and pantothenic acid. Riboflavin values first increased and then decreased during fermentation. A flavone in tempeh which is not present in soybeans was found to have antioxidant qualities. These findings were from a research contract under PL 480 in Japan.

Publication - USDA and Cooperative Program

Nutritional Status and Requirements

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Prepared in cooperation with the Consumer and Food Economics Research Division.

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Moyer, E. Z., and Irwin, M. I. 1967. Basic data on metabolic patterns in 7- to 10-year-old girls in selected southern States. USDA. Home Econ. Res. Rpt. 33, 167 pp.

Carbohydrates

Bar-on, H., and Stein, Y. 1968. Effect of glucose and fructose administration on lipid metabolism in the rat. J. Nutr., 94:95.

Chang, M. L. W. 1968. Liver enzymes influenced by dietary carbohydrate and egg. Fed. Proc. 27:258. (Abstract).

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Lakshmanan, F. L., Schuster, E. M. and Adams, M. 1967. Effect of dietary carbohydrate on the serum protein components of two strains of rats. J. Nutr. 93:117.

Lipids

Adams, M. 1968. Body composition, liver lipids and serum cholesterol of rats fed low or high cholesterol diets containing different types of fat. Fed. Proc. 27:222. (Abstract).

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Mukherjee, S., and Gupta, S. 1967. Effects of gonadal hormones on cholesterol metabolism in the rat. J. Atheroscler. Res., 7:435.

Proteins

Coons, C. M. 1968. Selected references on cereal grains in protein nutrition--human and experimental animal studies of major and minor cereals, 1910-1966. ARS 61-5, 150 pp.

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Fry, P. C., Leverton, R. M. and Goksu, S. 1967. Growth of Hong Kong children on diets containing rice or rice and wheat with and without nutrient supplements. Am. Jour. Clin. Nutr., 20:954.

Szmclman, S. 1967. Supplementation of a vegetable protein mixture. Canadian Journal of Biochemistry, 45:959-964.

Szmclman, S., and Guggenheim, K. 1967. Availability of amino acids in processed plant-protein foodstuffs. J. Sic. Fd. Agric., 18:347-350.

Guggenheim, K., and Szmclman, S. 1965. Protein-rich mixtures based on vegetable foods available in Middle-Eastern countries. Agri. Food Chem. 13:148-151.

Vitamins

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AREA NO. 2: QUALITY OF FOOD IN HOMES AND INSTITUTIONS

(RPA 704 - HOME AND COMMERCIAL PREPARATION OF FOOD)

USDA and Cooperative Program

Location of Intramural Work	Commodity	Scientist Man-years FY 1968
Maryland (Beltsville)	Food	1.6
Maryland (Beltsville)	Beef	1.5
Maryland (Beltsville)	Dairy	0.1
Maryland (Beltsville)	Pork	0.5
Maryland (Beltsville)	Lamb	0.4
Maryland (Beltsville)	Poultry	0.5
Maryland (Beltsville)	Deciduous and Small Fruits and Tree Nuts	0.5
Maryland (Beltsville)	Vegetables	1.2
Maryland (Beltsville)	Oilseeds	0.4
Maryland (Beltsville)	Wheat	2.7
		<hr/> Total 9.6

Intramural program is supplemented by extramural support representing (a) 0.0 SMY's at State Agricultural Experiment Stations, (b) 0.0 SMY's at other U. S. institutions, and (c) P.L. 480 funds in 0 countries representing 0.00 U. S. dollars equivalent.

Problems and Objectives

The quality attributes of foods which have been maintained through production, processing, and marketing can be adversely affected if foods are not properly handled in the home or institution. Diet recommendations are successful in improving diets and nutrition only if people are willing to make and adhere to the changes indicated. Thus, diet recommendations need to consider the food preferences of people, procedures for maintaining nutritional, texture, flavor, safety, and other qualities of the food during preparation, and the time and labor required for the consumer to prepare the foods suggested. The production, processing and marketing aspects of foods are changing rapidly and the consumer is continually confronted with new products and the need for new methods of preparing food.

Major objectives of the research are to develop and improve the procedures used by the consumer to prepare and handle food which will:

1. preserve or improve its nutritional value
2. enhance its eating quality
3. safeguard its wholesomeness
4. insure economy of labor and cost
5. result in foods and food combinations which will meet consumer acceptance and be conducive to improved dietaries.

Progress - USDA and Cooperative Programs

A. Food Use

1. Low-income families. Recipes for a broad range of commodities, including fruits, vegetables, rolled oats, cheese, nonfat dry milk, instant mashed potatoes, dry scrambled egg mix, and canned chicken were developed for use by low-income families participating in USDA food distribution programs. A pilot survey in two low income housing developments in Washington, D. C. showed these recipes to be useful and acceptable.

2. National School Lunch Program. About 170 recipes were developed or reevaluated for the School Lunch Program. These recipes covered a wide range of commodities, including canned chopped meat, sweetpotato flakes, canned grape juice, frozen french fried potatoes, peanut butter, raisins, dried eggs, rolled oats, and concentrated orange juice. In addition, yield and quality information on new forms of foods has been obtained. This information on recipes, yield and quality is essential for school lunch managers who are in charge of feeding almost 19 million children in the National School Lunch Program.

B. Animal Products

1. Beef. A roasting temperature of 325°F for beef tenderloins gave more servings of cooked meat than a roasting temperature of 425°F, the temperature usually recommended for this cut. The meat was more juicy and less mealy when cooked at 325° than at 425°.

The properties of muscle protein and the changes which take place during cooking are important factors in meat tenderness and texture. Tropomyosin B has been isolated from rabbit, porcine and bovine muscle and preliminary characterization begun. A method for isolating intramuscular connective tissue in the native state has been developed.

2. Lamb. Research on the natural flavor of lamb and yearling mutton meat indicated that flavor differences are insignificant. Differences were more readily recognized in broth than in meat slices. This was true whether the meat was roasted, broiled or braised.

The chemical constituents of lamb aroma also were studied. Characteristic cooked lamb aroma was isolated from heated lamb fat. The volatiles from lamb fat, about 1 percent of the starting material, contained the lamb aroma compounds. Extracts of lean lamb on heating produced only "meaty" aromas and no typical "lamb" aromas.

Not all lamb carcasses yield cuts that have "lamb" aroma. The cause of this difference has not been determined. This finding may be of significance to animal producers, processors, and consumers.

3. Poultry. Although differences in electrophoretic patterns were obtained between protein extracts from fresh and frozen turkeys, differences in eating quality of the roasted turkey meat were not related to these changes in turkey protein composition. Quantitative changes in the water extractable proteins of turkey meat occurred during 10 months storage at -5°F. Fresh turkeys which showed a fast rate of heat penetration required a higher end-point temperature for comparable doneness to frozen-thawed turkeys which took a longer time to reach a selected end-point temperature.

C. Horticultural Crops

1. Vegetables. Work was begun on procedures for improving color retention in green beans during food service. Green beans held on a steam table for 30 minutes will lose most of their chlorophyll, the green coloring material. Acids formed in the vegetable while held on the steam table are responsible for most of the color loss. Addition of a small amount of a mixture of calcium acetate and magnesium carbonate to the water before cooking of the vegetable will retard subsequent color loss in the green beans while held on the steam table. Panel evaluation indicates that the additive does not have an unfavorable effect on texture or color of the green beans.

D. Oilseeds and Peanuts

A procedure was developed for preparing good quality loaves of bread in which 25 percent of the wheat flour was replaced with oilseed flours. Best quality was obtained with soy flour as the replacement. Other oilseed flours ranked as safflower seed flour, glanded cottonseed flour (liquid-cyclone), glandless cottonseed flour and peanut flour. High levels of replacement (over 10 percent) of wheat flour usually caused poor loaf volume when customary methods of preparation were used. Changes in liquid, mixing time, or fat content of doughs produced dramatic increases in bread loaf volume. Increasing levels of replacement from 5 to 35 percent increased requirements for liquid and decreased strength of the dough.

E. Wheat

A study of the changes in nutrient composition of wheat during milling and processing of wheat bread products has been largely completed. Wheat flour contained little of the tocopherol and less than 30 percent of the vitamin B₆ of the whole grain. Hard and soft wheat flours retained about 25 percent of the thiamine and riboflavin of the whole wheat grain while flour from durum wheat retained about 50 percent of the thiamine and almost all of the riboflavin. In this study the durum wheats contained more thiamine than the hard and soft wheats.

The lipids of wheat grains and their flours (2.5 to 3.2 percent) were largely linoleic acid--over 50 percent of the total fatty acid content. A small amount of lipid material in the wheat grain was not extracted by solvents or solvent systems and needed an acid hydrolysis treatment to free it for analysis. This was also true of breads, cakes, and macaronis prepared from commercially milled flours. The extractable lipid from wheat and wheat flour contained more stearic acid, less palmitate, and usually more linoleate than the "bound" lipid.

Ten consumer available wheat products including breads, cereals, and doughnuts did not vary greatly in thiamine and riboflavin content among 10 cities selected as representative of a national sampling. Only 25 percent of vitamin B₆ in the whole grain was retained in baked products. Almost 50 percent of the vitamin B₆ was present as pyridoxine. Tocopherols in baked products made with vegetable shortening came mainly from the shortening. The fatty acids were not different among regions for comparable products.

Publication - USDA and Cooperative Program

Food Use

USDA. 1968. Family fare: food management and recipes. HG-1, 82 pp. (rev.)
In cooperation with the Consumer and Food Economics Research Division.

USDA. 1968. Baking for people with food allergies. HG-147, 12 pp.

USDA. 1968. Raisins, A good choice for the thrifty family. C&MS-60 4 pp.

USDA. 1968. Rolled Oats (quick cooking), A good choice for the thrifty family. C&MS-59, 4 pp.

USDA. 1968. Fruit in family meals: a guide for consumers. HG-125, 30 pp.

USDA. 1967. Lamb in family meals: a guide for consumers. HG-124, 22 pp.

USDA. 1967. Milk in family meals: a guide for consumers. HG-127, 22 pp.

Animal Products

Beef

Breidenstein, B. B., Anderson, D. B., Kauffman, R. G., Cassens, R. G., and Bray, R. W. 1967. Effects of heating on fatty acid composition of beef lipids. J. Animal Sci. 26:1472. (Abstract).

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Poultry

Fulton, L. H., Gilpin, G. L., and Dawson, E. H. 1967. Palatability and yield of whole and cut-up turkeys roasted from frozen and thawed states. J. Home Econ. 59:728.

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AREA NO. 3: SAFETY OF FOOD IN HOMES AND INSTITUTIONS

(RPA 702 - PROTECT FOOD SUPPLIES FROM HARMFUL MICROORGANISMS
AND NATURALLY OCCURRING TOXINS)

USDA and Cooperative Program

Location of Intramural Work	Scientist Man-years FY 1968
Maryland (Beltsville)	1.2
Total	1.2

Intramural program is supplemented by extramural support representing (a) 0.0 SMY's at State Agricultural Experiment Stations, (b) 0.0 SMY's at other U. S. institutions and (c) P.L. 480 funds in 0 countries representing 0.00 U. S. dollars equivalent.

Problems and Objectives

The conditions under which food is prepared for eating in homes and institutions provide many opportunities for microorganisms capable of causing illnesses to enter and grow in the food. Most are due to improper food handling practices. Whether food also serves as a medium for transfer of respiratory diseases is not known. The magnitude of the problem is great. In the year ending June 30, 1967 there were 590.8 million work and school days lost due to respiratory diseases and 62.8 million due to digestive diseases. Improved recommendations for food care in homes and food service institutions would have economic significance.

Major objectives of the research are to:

1. identify food combinations least conducive to microbial growth and toxin production
2. identify conditions of storing and holding food least conducive to microbial transfer and growth.

Progress - USDA and Cooperative Program

A. Prevention of Toxin Production

Preliminary studies of ways by which chemicals may alter the metabolism of microorganisms suggest metabolic sites where formation of toxic end products may be controlled. Strains of Staphylococci, Salmonella, and related organisms which cause food poisoning outbreaks have been studied.

Publications - USDA and Cooperative Program

None

AREA NO. 4: EFFECT OF PESTICIDE USE UPON HUMAN NUTRITION

(RPA-701 - Insure Food Products Free of Toxic Residues
from Agricultural Sources)

USDA and Cooperative Program

Location of Intramural Work	Commodity	Scientist
		Man-years FY 1968

Maryland (Beltsville)	Food and Diets	2.7
Maryland (Beltsville)	Wheat	2.7
Maryland (Beltsville)	Vegetables	2.9
Maryland (Beltsville)	Potatoes	0.6
Maryland (Beltsville)	Deciduous fruit	0.1
Maryland (Beltsville)	Pork	0.1
Maryland (Beltsville)	Peanuts	0.1
		<hr/>
		Total 9.2

Intramural program is supplemented by extramural support representing (a) 0.0 SMY's at State Agricultural Experiment Stations, (b) 1.6 SMY's at other U. S. institutions and (c) P.L. 480 funds in 0 countries representing 0.00 U. S. dollars equivalent.

Problems and Objectives

Pesticides and their residues are found in almost every food eaten by the consumer. They are present in the food supply at levels well below the tolerance levels established by the Food and Drug Administration. Little is known about the effect of consuming low levels of pesticides over long periods of time upon the metabolism of nutrients in humans. We need to know whether nutrient metabolism may be altered producing changes in cell functions, some of which may be apparent only in successive generations. We need to know whether the effects are adverse and if they are more likely to occur with dietary imbalances such as marginal or excessive levels of one or more nutrients. Changes also may occur in the nutritional and other qualities of foods due to the presence of pesticides during food production.

Major objectives of the research are to:

1. determine the effect of long term low level intakes of pesticides upon nutrient requirements.
2. determine whether proper diet may protect against adverse effects of pesticides in the diet
3. identify and measure the effects of the use of pesticides during production upon the nutritive value of foods
4. determine whether and how recommendations for diet selection and food preparation need to be adjusted as a result of the use of pesticides during food production.

Progress - USDA and Cooperative Programs

A. Food and Diets

1. Mineral metabolism and insecticides. Research carried out under contract with Purdue University indicates that the continual feeding of low levels of insecticides may alter copper metabolism and result in adverse changes in reproductive performance and in survival and development of normal progeny. The level of copper and the presence of a mixture of 2.4 ppm DDT, 0.33 ppm parathion and 2.3 ppm carbaryl in the diet had relatively little influence on growth of the female rat; however, both influenced reproductive performance. When copper levels were low, 1 ppm, or high, 300 ppm, survival to weaning was poor and was worse in the presence than in the absence of insecticides. The young from mothers fed the low copper diet with or without insecticides were hyperirritable, sensitive to noise and on autopsy showed evidence of brain damage and degenerative changes in nervous tissue. Heart lesions were seen occasionally in the absence of insecticides but were more frequent and more severe when the low copper diet contained insecticides.

Contract research at the University of Florida suggests that low intakes of insecticides may affect manganese metabolism with the effect apparent in

succeeding generations. The manganese content of the livers of the female rat and her young was significantly higher when the manganese level of the diet was 1500 ppm compared to 100 ppm; when similar diets contained insecticides, the amount of manganese in the liver was significantly higher in the mother, but in the young did not differ from the level observed in the absence of insecticides.

2. Plant proteins and insecticides. Research has been initiated under contract with Wisconsin Alumni Research Foundation to investigate the biochemical and physiological response of rats to diets containing rice with or without added lysine or lysine and threonine as the source of protein. The diets will be fed with and without the addition of malathion and DDT.

B. Wheat Fumigation

The storage phase of a 3-year storage study of wheat with 8 periodic fumigations has been completed. Effects upon nutrient and bread making qualities were investigated. Fumigants used were methyl bromide, phosphine, and ethylene dichloride/carbon tetrachloride. Overall quality of wheat deteriorated during the course of the study and was reflected in the poor eating quality of bread made from the flour. Phosphine had a particularly adverse effect on the bread-making qualities of wheat flour. Techniques and treatments for flour production may require modification should phosphine fumigation become more widely used. There was a consistent build up of inorganic bromide residue from 8 to 99 ppm as a result of methyl bromide fumigation.

C. Horticultural Crops

1. Vegetables. Asparagus grown in soil treated with the herbicides Monuron, Amiben, Diphenamid, Linuron or 732 was judged by a taste panel to have full natural flavor when compared to asparagus grown in untreated soil. Cooked asparagus from the treated plots was superior in color. Sweet corn was not changed in flavor when grown in plots treated with different levels of the herbicide atrazine. Differences in panel scores for texture and color were not of practical significance.

Research under contract at Washington, D. C. and Berkeley, California was completed on the effects of home and commercial food preparation on removing insecticides present near tolerance level on a variety of vegetables. DDT, carbaryl, and malathion were in general greatly reduced by preparation procedures. Peeling, where applicable removed residues almost completely. Parathion was used on spinach and broccoli and in both instances was difficult to remove. This indication that phosphate insecticide residues may be persistent requires confirmation.

2. Potatoes. Pentachloronitrobenzene (PCNB), a soil fungicide used against potato scab, has an adverse affect on flavor according to a minority of judges who apparently have an extremely low tolerance of PCNB. Potatoes

grown in PCNB-treated soil also were lower in free tyrosine content and showed less enzymatic browning than did untreated potatoes. This change in composition and quality caused by pesticide use is a beneficial one in that darkening of potatoes due to enzymatic browning is a problem in home and institutional food preparation.

D. Poultry and Eggs

A study has been made of the effect, on the nutritive value of eggs and on the eating quality of cooked meat, of 100 ppm and 1000 ppm malathion in the diet of young laying hens during an 8-week feeding trial. Neither level produced any toxic effect in the birds. Residues of malathion (less than 0.5 ppm) were found only in chicken fat, egg whites and egg yolks. Taste panel evaluations gave no indication of an effect on flavor of the cooked meat. Chemical analyses of egg whites and egg yolks showed no effect on nutrients including proximate composition, fatty acid distribution, amino acids, and carotene. The research was done under contract at Maspeth, New York.

E. Oilseeds and Peanuts

Peanuts from lindane-treated soil were found to be slightly higher in protein content and slightly lower in B-vitamin content than control peanuts. There were no differences in total solids and in lipids. Data on a succeeding crop are being obtained in contract research at College Station, Texas. Lindane is known to affect the metabolism of peanuts and this study is being done to determine whether the use of lindane also affects nutrient composition.

Publication - USDA and Cooperative Program

Food and Diets

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